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Seasonal Occurrence of Young Gulf Menhaden and Other Fishes in a Northwestern Florida Estuary

MARLIN E. TAGATZ and E. PETER H. WILKENS

SEATTLE, WA
August 1973

National Marine Fisheries Service, Special Scientific Report--Fisheries Series

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Seasonal Occurrence of Young Gulf Menhaden and Other Fishes in a Northwestern Florida Estuary

MARLIN E. TAGATZ[1] and E. PETER H. WILKENS[2]

ABSTRACT

Gulf menhaden, *Brevoortia patronus*, and other species of fishes were collected by plankton net, seine, and surface trawl from Pensacola Bay, East Bay, and East Bay River from December 1969 to October 1971. Relative abundance, distribution, and relative growth of menhaden are given from the time they enter the estuary as larvae in December to the time they emigrate to the Gulf of Mexico as juveniles in September.

Eighty-four species of fishes, representing 46 families, were captured. The number and length range of each species by month are presented for the areas from which it was caught. Also included are the salinity and temperature ranges at capture. Four species were not previously recorded from Pensacola estuaries.

INTRODUCTION

Of the three species of menhaden spawning in the Gulf of Mexico, only the young of the Gulf menhaden, *Brevoortia patronus*, occur in northwest Florida. The distribution of young Gulf menhaden is from southern Florida to the Mexican border; of yellowfin menhaden, *B. smithi*, from Sapelo Island, Ga., to Tampa Bay, Fla.; and of finescale menhaden, *B. gunteri*, from Matagorda, Tex., to the Gulf of Campeche in the western Gulf of Mexico (Reintjes and Pacheco, 1966). The distribution of eggs, larvae, and adults of Gulf menhaden in waters off the Florida coast indicates that spawning takes place near shore (within the 10-fm contour) from November through March (Turner, 1969). After an estimated 3 to 5 weeks from hatching, the larvae enter estuaries where further development occurs (Reintjes, 1969).

This report concerns the utilization of a Pensacola, Fla., estuary by young Gulf menhaden and by other species of fishes. Estuarine areas serve as nurseries for an extended period in the life cycle of menhaden and may be essential for the larvae to metamorphose (June and Chamberlin, 1959) and to undergo gonadogenesis (Combs, 1969). The seasonal distribution of young Gulf menhaden in an estuarine habitat of northwest Florida was studied for additional knowledge of the life history of this very important commercial species. The extent of that portion of the life history of Gulf menhaden that occurs in inside waters has been investigated in two other areas; monthly length frequency distributions were obtained by Suttkus (1956) for Lake Pontchartrain, La. and by Springer and Woodburn (1960) for the Tampa Bay area.

We collected other fishes to determine the clupeids and other species associated with menhaden in the estuary, to compile a list of some of the fishes occurring in an area characterized by a paucity of specimen records (upper East Bay and East Bay River), and to provide seasonal occurrence data on Pensacola fishes as a possible aid to any studies on their life histories or on the effects of decreased water quality on their local distribution. Early listings of fishes from the Pensacola area were given by Jordan and Gilbert (1882),

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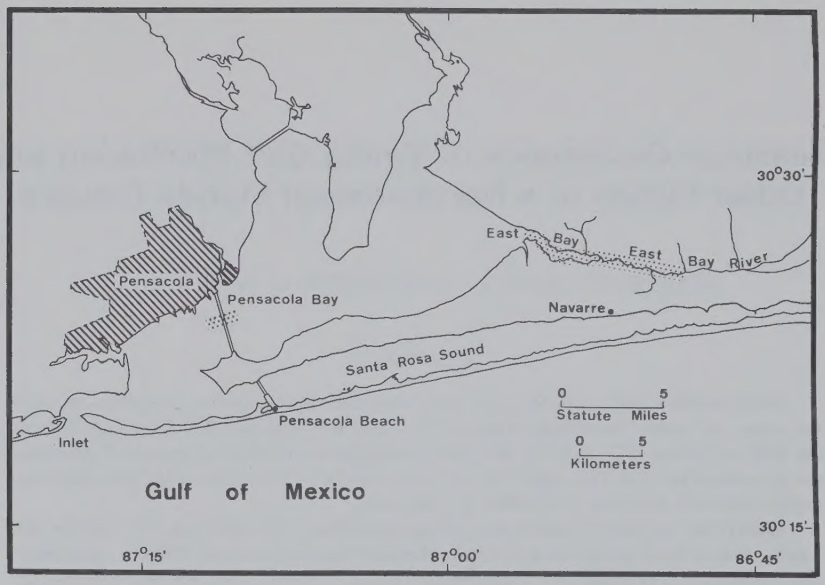

Figure 1.—Location of sampling areas (stippled) at the Pensacola Bay bridge and in the upper East Bay and lower East Bay River.

Bollman (1886), Gilbert (1891), and Evermann and Kendall (1900). More recently, Bailey et al. (1954) reported on collections of fishes from the Escambia River, and Smith-Vaniz (1968) gave records for the nearby Conecuh, Blackwater, and Yellow Rivers. Fish were included in an inventory by Cooley (in press) of the estuarine fauna in the vicinity of Pensacola; our report includes much data beyond the scope of Cooley's compilation.

METHODS AND AREAS SAMPLED

From December 1969 to October 1971, fishes were collected from the Pensacola bridge with a channel net and from the upper, constricted 4-mile portion (6.4 km) of East Bay and the lower 5 miles (8.0 km) of East Bay River with channel net, surface trawl, and seine (Fig. 1). The channel net, designed to catch larval menhaden in the surface currents, has a mouth opening of 1 by 3 m (3.3 by 9.8 ft) and tapers into a 1/2-m plankton net (1.6 ft; Lewis et al., 1970). A current meter suspended by floats near the net or towed with the net provided a measure to determine the volume of water strained. The 22-ft-wide trawl (6.7 m) has 1/4-inch bar mesh (6.4 mm), and the 70-ft-long seine (21.3 m) has a funnel-shaped bag of $^{5}/_{32}$-inch stretched mesh (4.0 mm). Salinities and water temperatures were measured with each collection with a salinometer. Water transparency (Secchi disk), dissolved oxygen (Azide modification of Winkler method), and pH (color comparator) were determined once monthly in East Bay and East Bay River during 1971.

The Pensacola Bay bridge is about 9 miles (14.5 km) from the Pensacola Inlet. The water, about 30 ft deep (9.1 m), generally was stratified with surface salinities ranging from 2.5 to 26.4 °/oo and those at the bottom from 25.5 to 33.7. Surface water temperature ranged from 5.2° to 31.2°C; bottom, 11.4° to 29.8°C.

Scattered dense stands of marsh grass border East Bay and East Bay River, and the immediate watershed was sparsely populated, nonindustrial, and heavily wooded. Most of the bay was less than 5 ft deep (1.5 m). The river had a channel depth of about 10 to 13 ft (3 to 4 m) and usually a swift current. Tannins imparted a dark tea color to the water. References to the lower bay in this paper refer to the lowermost 1 mile (1.6 km) of the constricted portion of East Bay. Salinity of the lower Bay ranged from 0 to 23.3 °/oo at the surface and from 0.9 to 25.3 at the bottom; the upper Bay, from 0 to 19.9 °/oo surface and from 0 to 24.0 bottom. Salinity of the River 3 miles

Table1.—Monthly occurrence of young Gulf menhaden in collections by channel net from Pensacola Bay and from East Bay and East Bay River, 1969-70 and 1970-71.

Location and month	1969-70				1970-71			
	Size[1] range TL	Maximum single catch			Size[1] range TL	Maximum single catch		
		Fish per 100 m³	Average size TL	Salinity S/B[2]		Fish per 100 m³	Average size TL	Salinity S/B[2]
	mm	*no.*	*mm*	*o/oo*	*mm*	*no.*	*mm*	*o/oo*
Pensacola Bay								
Nov.	--[3]	--	--	--	0	0	0	
Dec.	10-27	7.5	22.8	17.3/29.6	11-30	8.5	20.8	21.3/30.0
Jan.	14-29	1.0	22.6	18.5/30.1	24-29	0.5	26.4	15.4/29.6
Feb.	14-32	523.9	25.7	20.8/30.0	17-29	3.1	24.5	18.2/30.7
Mar.	14-31	40.4	22.4	10.9/26.8	12-27	1.9	22.1	12.7/29.0
Apr.	19-24	0.2	21.5	7.8/30.7	17-27	4.1	20.0	11.4/28.3
May	0	0	0	--	0	0	0	--
East Bay and East Bay River								
Dec.	0	0	0	--	24-32	4.1	28.3	21.5/23.4
Jan.	13-28	0.3	19.6	3.7/4.4	25-35	2.8	30.5	1.1/2.4
Feb.	20-33	66.5	26.0	11.2/11.3	23-39	13.8	28.4	11.0/11.2
Mar.	20-35	45.2	27.9	8.9/9.0	23-35	58.8	28.0	6.2/13.1
Apr.	25-46	8.0	39.4	1.6/10.7	27-54	2.3	32.6	0.4/4.6

[1] Includes all menhaden caught during month. [2] S/B = surface/bottom. [3] No sampling.

(4.8 km) upstream ranged from 0 to 2.3 °/oo surface and from 0 to 19.2 bottom. Water temperatures of the Bay ranged from a January low of 6.7°C to an August high of 31.7°C.

In summer and early fall, surface and bottom waters of the River were cooler (1° to 5°C) than those of the Bay, but in winter, the River usually was warmer (1° to 2°C) than the Bay. Dissolved oxygen readings were from 7 to 12 ppm. Water transparency of the River ranged from 80 to 300 cm (highest in September and October); of the Bay, 90 to 140 cm. The River was acidic (pH, 5.0-6.0) and the Bay was neutral or slightly alkaline (pH, 7.0-8.0).

The channel net was suspended from the Pensacola Bay bridge on 2 to 4 days each month for 2 or 3 consecutive ½-hr intervals per day. It was used primarily to capture larval fishes. The bridge site was chosen because surface-water currents were present to spread the net, and it allowed early collecting of those larvae entering the estuary through the inlet.

Each end of East Bay and the interface area of the River (between fresh water and a surface salinity of 0.5 o/oo) were sampled once or twice a month with channel net and surface trawl. Each net was towed for 10-min. periods between two 16-ft boats (4.9 m). The surface trawl was used primarily to capture postlarval fishes and was used at night because large juvenile menhaden could escape the net during the day. The thin elongated body of the menhaden larva begins to deepen at 30 mm, and by 33 mm the body has markedly deepened to the juvenile form. Our references to young include larvae and juveniles.

Sampling in East Bay and East Bay River also included monthly seining of two adjacent coves near the mid-southern-shore of the bay and monthly collecting with channel net, surface trawl, or seine at nonscheduled sites throughout the 9-mile study area (14.5 km). Collections were obtained at nonscheduled sites after regular sampling to better determine the distribution of menhaden in the bay and above and below the interface area.

The smallest and largest fish of each species in a sample were measured to the nearest mm TL (total length). All menhaden in catches of less than 100 and a subsample of 100 in larger catches were measured. Size distribution of juveniles for

Table 2.—Monthly occurrence of young Gulf menhaden in collections by surface trawl from East Bay and East Bay River, 1970 and 1971.

Month	1970				1971			
	Size[1] range TL	Maximum single catch			Size[1] range TL	Maximum single catch		
		Fish per 10-min tow	Average size TL	Salinity S/B		Fish per 10-min tow	Average size TL	Salinity S/B
	mm	*no.*	*mm*	*o/oo*	*mm*	*no.*	*mm*	*o/oo*
Mar.	25-48	209	29.4	3.0/19.9	28-36	41	31.0	3.8/5.4
Apr.	25-66	747	38.4	4.0/9.1	27-60	411	40.5	6.7/15.5
May	35-61	111	50.2	2.4/7.1	26-91	2,282	46.1	0.4/9.7
June	39-89	955	60.8	0.6/5.3	36-100	38,490	46.2	0/0
July	45-92	23,781	68.1	1.2/4.1	42-87	14,007	57.2	6.5/13.1
Aug.	43-106	924	57.4	0/0	50-128	316	105.3	12.2/19.6
Sept.	66-115	34	84.9	0/13.9	55-127	54	71.5	0.5/18.0
Oct.	90-120	1	90.0	0.8/19.6	90-130	4	114.0	7.8/17.0

[1]Includes all menhaden caught during month.

any month is based on two subsamples representing the largest catch at each of two locations (Bay and River or upper and lower Bay).

SEASONAL OCCURRENCE OF GULF MENHADEN

Only larval menhaden (smaller than 33 mm) were captured from the Pensacola Bay bridge (Table 1), and larvae and juveniles (larger than 32 mm) were caught from East Bay and East Bay River (Tables 1 and 2). Table 1 presents monthly occurrence of primarily larval menhaden in collections by channel net from East Bay and East Bay River, and Table 2 shows data on primarily juveniles captured by surface trawl from the same area. Occurrence of young for March and April is included in both tables because at this time many menhaden were either large larvae or small juveniles readily captured by either net.

Larval menhaden were captured at the Pensacola Bay bridge during a 5-mo period, December to April (Table 1). They ranged in size from 10 to 32 mm TL and were obtained from both flood and ebb-tide periods. If early growth is similar to that of yellowfin menhaden as described by Hettler (1970), the presence of fish as large as 26 mm early in December and as small as 17 mm near the end of April allows us to infer that the duration of spawning is at least from late October to late March. Suttkus (1956) obtained larvae in Louisiana only through March and presumed that spawning ended in February. Abundance of larvae in some February collections from the Bay agrees with the results of a fecundity study by Suttkus and Sundararaj (1961) that indicated a spawning peak in January. Smaller sizes occurred in the Bay in March and April than in the previous 2 mo. Gunter and Christmas (1960) stated that Baldauf (1954) hypothesized that occurrence of small menhaden near the end of the influx of larvae in a Texas estuary may represent a second spawning peak. Average monthly sizes of young from the Bay were smaller than those found by Suttkus (1956) and by Springer and Woodburn (1960), indicating that this species enters Pensacola estuaries at a smaller size than it does on the Louisiana and southern Florida coasts (or that collecting methods of the other two studies did not as readily catch the smaller young).

In East Bay and East Bay River, menhaden larvae first occurred during December in collections by channel net (Table 1), and larvae as small as 26 mm TL were found as late as mid-May in catches of juveniles by surface trawl (Table 2). By May, most of the larvae had metamorphosed into juveniles. The young school from the time they enter the estuary. Their early growth in East Bay and East Bay River was in the upper Bay and lower River, where salinities usually were less than 10 o/oo. Few larvae were found in the River, but after February the range of juveniles extended as far as 3 miles (4.8 km) up river. Juveniles occurred in freshwater but never

Table 3.—Monthly size distributions of Gulf menhaden in East Bay and East Bay River, April-September, 1971.

Size	Apr.	May	June	July	Aug.	Sept.
mm			*in percent*			
21-30	2					
31-40	57	25	6			
41-50	29	30	30	14	0.5	
51-60	7	14	10	24	14	5
61-70		6	15	24	14	32
71-80		2	30	21	1	38
81-90		0.5	1	11	1	12
91-100	0.5	0.5		1	14	1
101-110	1	1			24	2
111-120	2	14			14	4
121-130	2	5	5		7	2
131-140		1	2	4	2	
141-150		1		2	6	
151-160					2	3

more than 1 mile (1.6 km) from the freshwater-low salinity zone. As the young increased in size they moved downstream to the lower Bay where salinities generally were greater than 10 o/oo. In June 1971, for example, the average sizes of fish were 72.5 mm in the lower Bay and 46.2 mm in the upper Bay. The smallest juveniles were found in the River. The fishes in the Bay averaged from 3 mm larger in April to 45 mm larger in August than those in the River. Collections by seine indicated that larval and juvenile menhaden also occurred inshore during the months they were captured by channel net and trawl. Relative abundance and sizes of young in these shallow waters were similar to those of fishes caught at comparable times offshore.

Young, 31 to 50 mm TL, in April 1971 appeared to attain a size of 91 to 120 mm by August (Table 3). They probably emigrated Gulfward in September since few fish over 90 mm were captured that month. The small size of all catches after August indicated that most juveniles had moved out of the estuary (Table 2). The time of emigration of juveniles from estuarine waters agrees with the results of Suttkus (1956) for Louisiana but not with those of Springer and Woodburn (1960), who indicated that movement from Tampa Bay occurred in June or July. The bimodality of lengths evident for June and for August in Table 3 indicates two spawning peaks, as did the larval data for Pensacola Bay.

Yearlings, hatched late in the 1969-70 spawning season, also appeared in East Bay and East Bay River from April (over 90 mm long) to September (over 150 mm long) in 1971 (Table 3). In Table 3, size distributions were based on two subsamples representing the largest catches in the Bay and the River.

SIGNIFICANT ASSOCIATES

Anchovies may be the most important competitors to menhaden for food and space in the East Bay River area. The striped anchovy, *Anchoa hepsetus*, and particularly the bay anchovy, *A. mitchilli*, were abundant in the bay at the same time and at similar lengths as the Gulf menhaden. In December, for example, 113 menhaden, 24 to 32 mm, were collected in a seine haul with 5,250 bay anchovy, 20 to 35 mm. Both species form large schools, and anchovies and the larval stage of menhaden feed by filtering zooplankton.

Various clupeids occurred with menhaden but in numbers too small to suggest serious competition. Captured were 52 threadfin shad, *Dorosoma petenense*, one skipjack herring, *Alosa chrysochloris*, and eight scaled sardines, *Harengula pensacolae*.

The silver perch, *Bairdiella chrysura*, and probably many other species of fishes prey on young menhaden in East Bay and East Bay River. In the only stomach analysis of this study, 8 of 12 perch (152 to 199 mm) had 1 to 3 whole menhaden (45 to 55 mm) in their stomachs. All the predators on menhaden found by Reid (1955), *Cynoscion arenarius*, *Micropogon undulatus*, *Arius felis*, *Bagre marinus*, *Elops saurus*, and *Synodus foetens*, were also found in our study area.

SEASONAL OCCURRENCE OF OTHER FISHES

A summary of the number and size ranges of species caught in this study is presented in Table 4. Nomenclature and taxonomic arrangement follow Bailey et al. (1970). Gulf menhaden and bay anchovy made up approximately 92% by number of all fish captured. Species not previously recorded from the Pensacola bays and rivers are flat anchovy, *Anchoviella perfasciata*; rough silversides, *Membras martinica*; chain pipefish, *Syngnathus louisianae*; and web burrfish, *Chilomycterus antillarum*. The only other

Table 4.—Total number of fishes caught at the Pensacola Bay bridge and the East Bay-East Bay River area.

Species	Number	Total length range (mm)
Dasyatis sabina, Atlantic stingray	7	457-685
Lepisosteus osseus, longnose gar	73	20-1,016
Elops saurus, ladyfish	7	29-41
Megalops atlantica, tarpon	1	29
Myrophis punctatus, speckled worm eel	370	53-224
Alosa chrysochloris, skipjack herring	1	146
Brevoortia patronus, Gulf menhaden	119,184	10-262
Dorosoma petenense, threadfin shad	52	70-195
Harengula pensacolae, scaled sardine	9	53-88
Opisthonema oglinum, Atlantic thread herring	1	9
Anchoa hepsetus, striped anchovy	3,600	5-133
Anchoa mitchilli, bay anchovy	67,427	4-89
Anchoviella perfasciata, flat anchovy	8	27-48
Esox americanus americanus, redfin pickerel	1	257
Synodus foetens, inshore lizardfish	19	29-116
Notropis cummingsae, dusky shiner	21	21-46
Notropis petersoni, coastal shiner	109	36-82
Noturus leptacanthus, speckled madtom	2	41-45
Arius felis, sea catfish	6	278-413
Bagre marinus, gafftopsail catfish	6	110-540
Aphredoderus sayanus, pirate perch	12	14-29
Porichthys porosissimus, Atlantic midshipman	1	30
Gobiesox strumosus, skilletfish	7	10-58
Urophycis floridanus, southern hake	1	33
Hyporhamphus unifasciatus, halfbeak	4	35-284
Strongylura marina, Atlantic needlefish	52	27-563
Cyprinodon variegatus, sheepshead minnow	19	39-67
Fundulus grandis, Gulf killifish	90	18-157
Fundulus similis, longnose killifish	573	18-132
Gambusia affinis, mosquitofish	51	23-38
Labidesthes sicculus, brook silverside	217	19-81
Membras martinica, rough silverside	1,454	7-122
Menidia beryllina, tidewater silverside	4,111	5-118
Hippocampus erectus, lined seahorse	7	26-41
Hippocampus zosterae, dwarf seahorse	1	19
Syngnathus floridae, dusky pipefish	4	29-59
Syngnathus louisianae, chain pipefish	51	24-152
Syngnathus scovelli, Gulf pipefish	16	22-113
Mycteroperca microlepis, gag	1	178
Lepomis macrochirus, bluegill	1	124
Micropterus salmoides, largemouth bass	2	58-83
Etheostoma edwini, brown darter	2	32-36
Percina nigrofasciata, blackbanded darter	2	37-45
Caranx hippos, crevalle jack	12	40-141
Chloroscombrus chrysurus, Atlantic bumper	102	5-88
Decapterus punctatus, round scad	3	15-26
Oligoplites saurus, leatherjacket	45	4-68
Vomer setapinnis, Atlantic moonfish	8	80-112
Lutjanus griseus, gray snapper	1	16
Eucinostomus argenteus, spotfin mojarra	1	82
Eucinostomus lefroyi, mottled mojarra	419	11-55
Eucinostomus sp.	3	13-16
Orthopristis chrysoptera, pigfish	37	4-26
Lagodon rhomboides, pinfish	1,470	8-156
Bairdiella chrysura, silver perch	311	90-212
Cynoscion arenarius, sand seatrout	155	30-305
Cynoscion nebulosus, spotted seatrout	42	28-330
Leiostomus xanthurus, spot	1,922	7-234
Menticirrhus focaliger, minkfish	1	29
Micropogon undulatus, Atlantic croaker	618	7-238
Sciaenops ocellata, red drum	7	54-140
Chaetodipterus faber, Atlantic spadefish	3	13-126
Mugil cephalus, striped mullet	206	26-309
Mugil curema, white mullet	5	4-181
Sphyraena borealis, northern sennet	17	31-40
Astroscopus y-graecum, southern stargazer	2	15-22
Hypsoblennius sp.	44	4-13
Gobionellus boleosoma, darter goby	58	10-43
Gobionellus hastatus, sharptail goby	4	44-78
Gobiosoma bosci, naked goby	17	11-47
Unknown Gobiidae	37	6-10
Trichiurus lepturus, Atlantic cutlassfish	5	223-795
Scomberomorus maculatus, Spanish mackerel	4	65-152
Peprilus alepidotus, harvestfish	62	11-135
Peprilus triacanthus, butterfish	29	13-150
Prionotus tribulus, bighead searobin	12	6-86
Citharichthys spilopterus, bay whiff	11	10-101
Paralichthys lethostigma, southern flounder	3	32-59
Unknown Bothidae	9	9-14
Achirus lineatus, lined sole	4	3-51
Trinectes maculatus, hogchoker	25	10-96
Symphurus plagiusa, blackcheek tonguefish	14	17-60
Aluterus schoepfi, orange filefish	1	57
Monacanthus hispidus, planehead filefish	18	13-30
Sphoeroides nephelus, southern puffer	20	7-92
Chilomycterus antillarum, web burrfish	2	17
Chilomycterus schoepfi, striped burrfish	1	215

record for spotfin mojarra, *Eucinostomus argenteus*, known to us was reported by Bailey et al. (1954) from the Escambia River. A leptocephalus of tarpon, *Megalops atlantica*, from East Bay represents the second and most northern record of a larval tarpon in the Gulf of Mexico (Tagatz, 1973).

The following is a taxonomic list of all fishes collected, 84 species representing 46 families. Forty-four species were obtained from the Pensacola Bay bridge and 75 from the East Bay-East Bay River area with 35 of these common to both areas. The number and length of each species by month are listed for the areas from which it was captured: Bridge (Pensacola Bay bridge), Bay (upper 4 miles or 6.4 km of East Bay) and River (lower 5 miles or 8.0 km East Bay River). Also given are the salinity and temperature ranges at the time of collection. The low value of each range is based on the lowest combination of surface and bottom readings (presented in the order, surface/bottom) taken at any one time; the high value, on the highest combination. Salinity is in parts per thousand, water temperature in degrees C, and total length in millimeters.

Family Dasyatidae

Dasyatis sabina (Lesueur). Atlantic stingray.

BAY: Salinity 7.3/7.3-9.6/20.3, temperature 21.9/21.9-26.8/25.3. Number and length: Apr. (1, 559); May (6, 457-685).

Family Lepisosteidae

Lepisosteus osseus (Linnaeus). Longnose gar.
BAY: Salinity 0/0-19.9/24.0, temperature 16.6/16.6-31.2/30.9. Number and length: Feb. (3, 762-914); May (3, 520-660); June (5, 508-1,016); July (8, 609-914); Aug. (2, 762-914); Sept. (3, 762-914).
RIVER: Salinity 1.3/1.7-4.7/22.5, temperature 23.2/23.6-26.0/31.9. Number and length: May (38, 20-25); Aug. (1, 870); Sept. (10, 508-787).

Family Elopidae

Elops saurus Linnaeus. Ladyfish.

BAY: Salinity 1.5/1.5-6.7/11.3, temperature 16.6/16.6-27.3/27.3. Number and length: Apr. (5, 29-41); May (1, 38).
RIVER: Salinity 0/0, temperature 15.3/15.3. Number and length: Mar. (1, 39).

Megalops atlantica Valenciennes. Tarpon.

BAY: Salinity 7.3/11.5, temperature 20.1/21.6. Number and length: Oct. (1, 29).

Family Ophichthidae

Myrophis punctatus Lütken. Speckled worm eel.

BRIDGE: Salinity 8.8/29.5-24.0/29.5, temperature 5.3/11.4-17.0/22.7. Number and length: Jan. (111, 57-85); Feb. (35, 69-86); Mar. (13, 64-83); Nov. (4, 56-66); Dec. (52, 53-78).
BAY: Salinity 2.6/2.6-23.3/23.8, temperature 7.5/7.5-23.7/23.4. Number and length: Jan. (4, 57-70); Feb. (142, 66-89); Mar. (3, 54-83); Apr. (2, 59-190); May (2, 181-188); Sept. (1, 224); Dec. (1, 67).

Family Clupeidae

Alosa chrysochloris (Rafinesque). Skipjack herring.

BAY: Salinity 16.7/23.1, temperature 13.6/13.0. Number and length: Feb. (1, 146).

Brevoortia patronus Goode. Gulf menhaden.

BRIDGE: Salinity 2.8/29.6-26.4/29.5, temperature 5.2/11.4-24.8/19.7. Number and length: Jan. (29, 14-29); Feb. (3,593, 14-32); Mar. (876, 12-31); Apr. (129, 17-27); Dec. (413, 10-30).
BAY: Salinity 0/0-23.3/23.8, temperature 7.5/7.4-31.7/31.7. Number and length: Jan. (129, 13-35); Feb. (1,621, 20-39); Mar. (1,958, 20-48); Apr. (5,713, 23-169); May (6,916, 26-157); June (42,977, 36-181); July (49,738, 42-230); Aug. (699, 58-262); Sept. (49, 55-158); Oct. (18, 90-250); Dec. (174, 24-32).
RIVER: Salinity 0/0-4.7/22.5, temperature 15.3/15.3-28.9/30.2. Number and length: Feb. (1, 29); Mar. (24, 26-36); Apr. (181, 28-54); May (2,282, 30-75); Aug. (1,571, 43-88); Sept. (91, 58-115); Oct. (2, 90-120).

Dorosoma petenense (Günther). Threadfin shad.

BAY: Salinity 0/0-17.6/25.0, temperature 13.6/13.0-31.7/31.7. Number and length: Feb. (1, 135); Mar. (1, 195); Apr. (31, 100-160); May (4, 129-137); July (4, 125-144); Aug. (6, 77-173).
RIVER: Salinity 0/13.9-4.7/22.5, temperature 19.3/22.8-26.0/31.9. Number and length: Sept. (4, 70-112); Oct. (1, 122).

Harengula pensacolae Goode and Bean. Scaled sardine.

BRIDGE: Salinity 21.6/30.2, temperature 27.0/28.5. Number and length: Sept. (1, 53).
BAY: Salinity 10.0/19.0-23.3/23.5, temperature 30.2/30.3-31.7/31.7. Number and length: Aug. (5, 59-88); Sept. (3, 69-76).

Opisthonema oglinum (Lesueur). Atlantic thread herring.

BRIDGE: Salinity 21.6/30.2, temperature 27.0/28.5. Number and length: Sept. (1, 9).

Family Engraulidae

Anchoa hepsetus (Linnaeus). Striped anchovy.

BRIDGE: Salinity 7.2/30.0-24.2/30.4, temperature 12.1/18.7-31.2/29.2. Number and length: Mar. (5, 11-13); Apr. (941, 5-24); May (642, 5-29); June (88, 8-33); July (651, 8-35); Aug. (131, 7-35); Sept. (2, 21-35); Nov. (9, 28-33).
BAY: Salinity 3.2/7.5-23.3/23.5, temperature 16.5/13.8-31.7/31.7. Number and length: Jan. (1, 106); Apr. (10, 16-121);

May (550, 8-52); June (273, 29-120); July (28, 42-74); Aug. (74, 63-131); Sept. (29, 71-119); Oct. (166, 52-133).

Anchoa mitchilli (Valenciennes). Bay anchovy.

BRIDGE: Salinity 8.8/28.7-24.9/30.9, temperature 12.1/15.4-29.3/29.8. Number and length: Mar. (1, 13); May (23,334, 4-20); June (4, 8-18); July (11, 6-10); Aug. (2, 17-18); Sept. (153, 6-18); Dec. (1, 27).
BAY: Salinity 0/0-23.3/23.5, temperature 8.3/8.2-31.7/31.7. Number and length: Jan. (2,541, 21-73); Feb. (2,074, 25-77); Mar. (5,554, 29-87); Apr. (1,450, 29-80); May (4,043, 7-76); June (1,090, 10-82); July (956, 18-81); Aug. (6,850, 19-89); Sept. (2,368, 8-74); Oct. (8,206, 9-85); Nov. (1,726, 20-67); Dec. (6,382, 20-73).
RIVER: Salinity 0/0-4.7/22.5, temperature 13.8/13.8-28.9/30.2. Number and length: Mar. (15, 47-65); Apr. (12, 34-53); May (1, 9); July (10, 48-53); Aug. (356, 27-67); Sept. (216, 45-68); Oct. (71, 50-80).

Anchoviella perfasciata (Poey). Flat anchovy.

BRIDGE: Salinity 20.8/30.0-23.8/29.5, temperature 9.6/13.4-18.2/17.5. Number and length: Feb. (1, 41); Dec. (4, 27-38).
BAY: Salinity 8.5/21.4-14.1/20.0, temperature 12.7/14.0-27.4/25.4 Number and length: Feb. (1, 41); Mar. (1, 41); Oct. (1, 48).

Family Esocidae

Esox americanus americanus Gmelin. Redfin pickerel.

RIVER: Salinity 0/0, temperature 21.2/22.6. Number and length: Apr. (1, 257).

Family Synodontidae

Synodus foetens (Linnaeus). Inshore lizardfish.

BRIDGE: Salinity 8.8/28.7-19.5/32.0, temperature 24.8/19.7-27.4/28.9. Number and length: Apr. (2, 29-32); May (7, 33-41); July (1, 35); Aug. (3, 31-34).
BAY: Salinity 7.0/7.0-21.1/21.3, temperature 23.7/23.7-29.8/29.9. Number and length: May (2, 39-40); June (3, 37-63); Aug. (1, 116).

Family Cyprinidae

Notropis cummingsae Myers. Dusky shiner.

RIVER: Salinity 0/0, temperature 25.0/28.0-23.1/30.0. Number and length: Sept. (11, 21-44); Oct. (10, 21-46).

Notropis petersoni Fowler. Coastal shiner.

BAY: Salinity 0/0-2.3/9.7, temperature 14.1/14.3. Number and length: Feb. (5, 64-70); Mar. (13, 63-77); June (1, 70).
RIVER: Salinity 0/0-1.8/16.2, temperature 15.3/15.3-26.7/26.1. Number and length: Mar. (8, 57-72); May (1, 54); June (4, 50-64); Aug. (4, 42-75); Oct. (66, 36-82); Nov. (7, 45-58).

Family Ictaluridae

Noturus leptacanthus Jordan. Speckled madtom.

RIVER: Salinity 0/0, temperature 23.1/30.0. Number and length: Oct. (2, 41-45).

Family Ariidae

Arius felis (Linnaeus). Sea catfish.

BAY: Salinity 0.3/9.8-4.8/10.3, temperature 19.2/18.8-31.2/31.1. Number and length: Apr. (3, 325-413); July (3, 278-357, all mouths contained eggs and newly hatched young—16-27 mm).

Bagre marinus (Mitchill). Gafftopsail catfish.

BAY: Salinity 0.8/4.6-17.6/25.0, temperature 21.1/20.0-29.8/29.9. Number and length: Apr. (1, 540); June (1, 490, mouth contained eggs and newly hatched young—24-26 mm); Aug. (4, 110-128).

Family Aphredoderidae

Aphredoderus sayanus (Gilliams). Pirate perch.

RIVER: Salinity 2.3/3.9-1.8/16.2, temperature 23.2/23.6-22.9/25.9. Number and length: May (12, 14-29).

Family Batrachoididae

Porichthys porosissimus (Valenciennes). Atlantic midshipman.

BAY: Salinity 0.8/4.6, temperature 26.5/25.2. Number and length: June (1, 30).

Family Gobiesocidae

Gobiesox strumosus Cope. Skilletfish.

BRIDGE: Salinity 10.4/28.3-25.8/30.6, temperature 12.6/15.7-24.7/19.7. Number and length: Apr. (2, 12-13); Nov. (1, 14); Dec. (1, 15).
BAY: Salinity 6.7/11.3-21.1/21.3, temperature 17.9/17.7-26.7/26.7. Number and length: Apr. (1, 58); May (1, 10); Dec. (1, 14).

Family Gadidae

Urophycis floridanus (Bean and Dresel). Southern hake.

BRIDGE: Salinity 26.4/30.5, temperature 13.2/16.5. Number and length: Dec. (1, 33).

Family Exocoetidae

Hyporhamphus unifasciatus (Ranzani). Halfbeak.

BRIDGE: Salinity 17.0/30.2-22.3/32.9, temperature 28.0/24.7-29.2/28.7. Number and length: June (1, 63); Aug. (2, 35-39).
BAY: Salinity 15.4/23.3, temperature 17.9/17.7. Number and length: Dec. (1, 284).

Family Belonidae

Strongylura marina. (Walbaum). Atlantic needlefish.

BRIDGE: Salinity 8.9/28.7-14.7/33.7, temperature 27.5/22.4-28.1/26.8. Number and length: May (1, 27); July (1, 46).
BAY: Salinity 0.3/0.3-23.3/23.8, temperature 13.5/13.5-

31.1/31.0. Number and length: Feb. (2, 406-495); Mar. (7, 345-448); Apr. (2, 380-400); May (8, 64-121); June (6, 58-450); July (6, 92-238); Aug. (3, 89-166); Sept. (3, 308-457); Oct. (2, 540-563); Nov. (3, 387-438); Dec. (1, 368).
RIVER: Salinity 1.0/13.4, temperature 23.7/28.7. Number and length: Oct. (7, 508-533).

Family Cyprinodontidae

Cyprinodon variegatus Lacépède. Sheepshead minnow.

BAY: Salinity 7.7/7.7-17.6/25.0, temperature 20.0/17.4-29.8/29.9. Number and length: Apr. (4, 39-57); May (2, 53-67); Aug. (11, 39-65); Oct. (2, 45-56).

Fundulus grandis Baird and Girard. Gulf killifish.

BAY: Salinity 0.3/0.3-17.6/25.0, temperature 15.7/15.7-31.0/31.0. Number and length: Jan. (15, 78-130); Feb. (4, 72-100); Apr. (8, 65-115); May (11, 42-97); June (16, 61-142); July (3, 36-57); Aug. (8, 50-157); Sept. (3, 27-72); Oct. (11, 73-97); Nov. (4, 18-88); Dec. (7, 36-125).

Fundulus similis (Baird and Girard). Longnose killifish.

BAY: Salinity 0/0-17.6/25.0, temperature 16.2/16.2-31.0/31.0. Number and length: Jan. (2, 66-68); Mar. (9, 51-95); Apr. (78, 29-132); May (43, 25-126); June (29, 22-110); July (20, 35-85); Aug. (259, 20-122); Sept. (92, 18-114); Oct. (41, 21-93).

Family Poeciliidae

Gambusia affinis (Baird and Girard). Mosquitofish.

RIVER: Salinity 0/0, temperature 20.3/20.3. Number and length: Apr. (51, 23-38).

Family Atherinidae

Labidesthes sicculus (Cope). Brook silverside.

BAY: Salinity 0/0, temperature 27.8/27.8. Number and length: Aug. (3, 33-47).
RIVER: Salinity 0/0-0.5/18.8, temperature 11.8/11.8-27.4/28.5. Number and length: Jan. (4, 44-72); Feb. (9, 37-79); Mar. (5, 57-77); Apr. (8, 55-65); May (13, 56-79); June (15, 60-80); July (34, 19-68); Aug. (18, 26-58); Sept. (7, 37-54); Oct. (62, 34-81); Nov. (11, 40-72); Dec. (28, 40-81).

Membras martinica (Valenciennes). Rough silverside.

BRIDGE: Salinity 8.8/28.7-20.4/29.8, temperature 25.9/25.8-29.0/26.7. Number and length: May (27, 8-25); June (5, 10-24); July (10, 9-17); Sept. (1, 7).
BAY: Salinity 0/0-23.3/23.8, temperature 13.5/13.5-31.7/31.7. Number and length: Jan. (33, 55-110); Feb. (2, 93-95); Mar. (92, 66-116); Apr. (168, 51-122); May (896, 16-109); June (49, 20-107); July (112, 15-107); Aug. (25, 33-79); Sept. (11, 30-69); Oct. (11, 34-76); Nov. (4, 61-86); Dec. (8, 72-95).

Menidia beryllina (Cope). Tidewater silverside.

BRIDGE: Salinity 9.8/29.9, temperature 26.3/26.2; Number and size: Apr. (44, 5-21).
BAY: Salinity 0/0-17.6/25.0, temperature 6.8/6.7-31.0/31.0. Number and length: Jan. (56, 44-106); Feb. (16, 49-104); Mar. (19, 10-99); Apr. (159, 11-115); May (465, 16-109); June (655, 17-118); July (539, 28-78); Aug. (852, 32-105); Sept. (245, 19-110); Oct. (930, 17-97); Nov. (103, 21-84); Dec. (26, 77-94).
RIVER: Salinity 0.5/18.8, temperature 24.5/27.9. Number and length: May (2, 96-98).

Family Syngnathidae

Hippocampus erectus Perry. Lined seahorse.

BRIDGE: Salinity 13.3/30.9-24.2/30.4, temperature 16.1/22.7-31.2/29.2. Number and length: July (1, 31); Aug. (2, 36-40); Sept. (1, 40); Oct. (1, 41); Nov. (1, 31).
RIVER: Salinity 0/16.3, temperature 20.5/21.5. Number and length: Oct. (1, 26).

Hippocampus zosterae Jordan and Gilbert. Dwarf seahorse.

BRIDGE: Salinity 17.2/30.2, temperature 29.5/28.7. Number and length: Aug. (1, 19).

Syngnathus floridae (Jordon and Gilbert). Dusky pipefish.

BRIDGE: Salinity 8.8/28.7-24.6/30.9, temperature 23.4/21.5-29.0/29.2. Number and length: Apr. (1, 47); May (1, 32); Sept. (2, 29-59).

Syngnathus louisianae Günther. Chain pipefish.

BRIDGE: Salinity 8.9/28.7-24.2/30.4, temperature 23.3/21.5-29.3/29.8. Number and length: Apr. (4, 53-69); May (5, 51-70); June (7, 28-75); July (26, 24-83); Aug. (1, 76); Sept. (1, 68).
BAY: Salinity 7.0/7.0-17.6/25.0, temperature 16.5/14.5-29.8/29.9. Number and length: Jan. (1, 60); June (1, 84); Aug. (1, 152); Sept. (1, 74); Oct. (1, 150); Nov. (1, 84); Dec. (1, 59).

Syngnathus scovelli (Evermann and Kendall). Gulf pipefish.

BRIDGE: Salinity 7.7/30.4-25.8/30.5, temperature 12.6/15.4-24.6/19.7. Number and length: Mar. (1, 22); Apr. (2, 26-43); Dec. (1, 32).
BAY: Salinity 4.1/4.1-23.3/23.8, temperature 12.7/13.5-24.1/24.1. Number and length: Feb. (4, 25-60); Mar. (1, 75); Apr. (5, 25-113); May (1, 107); Nov. (1, 106).

Family Serranidae

Mycteroperca microlepis (Goode and Bean). Gag.

BAY: Salinity 16.8/20.6, temperature 28.1/29.5. Number and size: Oct. (1, 178).

Family Centrarchidae

Lepomis macrochirus Rafinesque. Bluegill.

RIVER: Salinity 0/0, temperature 23.1/30.0. Number and length: Oct. (1, 124).

Micropterus salmoides (Lacépède). Largemouth bass.

BAY: Salinity 0.3/0.3-9.7/9.7, temperature 31.0/31.0-31.1/31.0. Number and length: June (1, 58); July (1, 83).

Family Percidae

Etheostoma edwini (Hubbs and Cannon). Brown darter.

RIVER: Salinity 0/0, temperature 23.1/30.0. Number and length: Oct. (2, 32-36).

Percina nigrofasciata (Agassiz). Blackbanded darter.

RIVER: Salinity 0/0, temperature 23.1/30.0. Number and length: Oct. (2, 37-45).

Family Carangidae

Caranx hippos (Linnaeus). Crevalle jack.

BRIDGE: Salinity 24.2/30.4, temperature 29.3/29.8. Number and length: Sept. (1, 40).
BAY: Salinity 0/0-18.1/18.1, temperature 27.8/27.8-31.7/31.7. Number and length: Aug. (9, 58-141); Oct. (1, 75).
RIVER: Salinity 4.7/22.5, temperature 26.0/31.9. Number and length: Sept. (1, 59).

Chloroscombrus chrysurus (Linnæus). Atlantic bumper.

BRIDGE: Salinity 13.3/30.9-24.9/30.9, temperature 21.2/23.5-29.5/29.4. Number and length: July (1, 16); Aug. (36, 6-40); Sept. (18, 5-45); Oct. (4, 13-35).
BAY: Salinity 5.2/15.0-23.3/23.5, temperature 22.4/23.1-30.8/30.8. Number and length: Aug. (12, 60-88); Sept. (26, 22-76); Oct. (4, 40-57).
RIVER: Salinity 0.4/14.4, temperature 23.5/25.0. Number and length: Oct. (1, 52).

Decapterus punctatus (Agassiz). Round scad.

BRIDGE: Salinity 15.1/30.6-14.7/33.7, temperature 28.1/24.8-28.1/26.8. Number and length: June (1, 15); July (2, 24-26).

Oligoplites saurus (Bloch and Schneider). Leatherjacket.

BRIDGE: Salinity 19.3/29.8-22.7/33.2, temperature 25.9/25.8-29.5/29.4. Number and length: May (3, 4-14); July (1, 18); Aug. (1, 22).
BAY: Salinity 4.8/5.1-21.1/21.3, temperature 23.7/23.7-31.7/31.7. Number and length: May (7, 9-19); June (1, 13); July (4, 31-58); Aug. (3, 36-45); Sept. (2, 36-45); Oct. (23, 23-68).

Vomer setapinnis (Mitchill). Atlantic moonfish.

BAY: Salinity 16.8/20.6-17.6/25.0, temperature 28.1/29.5-29.8/29.9. Number and length: Aug. (7, 80-105); Oct. (1, 112).

Family Lutjanidae

Lutjanus griseus (Linnaeus). Gray snapper.

BRIDGE: Salinity 19.5/30.6, temperature 29.2/29.4. Number and length: Aug. (1, 16).

Family Gerreidae

Eucinostomus argenteus Baird and Girard. Spotfin mojarra.

BAY: Salinity 9.0/9.0, temperature 21.2/21.2. Number and length: Sept. (1, 82).

Eucinostomus lefroyi (Goode). Mottled mojarra.

BAY: Salinity 0/0-8.7/19.2, temperature 16.1/16.1-29.3/29.3. Number and length: Aug. (326, 13-52); Sept. (31, 12-55); Oct. (5, 30-43); Nov. (36, 11-44).
RIVER: Salinity 0/16.3, temperature 20.5/21.5. Number and length: Oct. (21, 14-20).

Eucinostomus sp.

BRIDGE: Salinity 18.7/32.0-22.2/28.8, temperature 23.4/21.5-29.0/26.7. Number and length: Apr. (1, 16); July (2, 13).

Family Pomadasyidae

Orthopristis chrysoptera (Linnaeus). Pigfish.

BRIDGE: Salinity 9.8/29.8-19.9/29.8, temperature 25.9/25.8-26.4/26.0. Number and length: Apr. (17, 5-15); May (5, 4-12).
BAY: Salinity 2.5/2.5-8.2/11.3, temperature 20.2/20.2-26.6/26.6. Number and length: Apr. (10, 12-18); May (5, 17-26).

Family Sparidae

Lagodon rhomboides (Linnaeus). Pinfish.

BRIDGE: Salinity 7.8/30.7-26.4/30.4, temperature 5.2/11.4-29.3/29.8. Number and length: Jan. (6, 13-18); Feb. (516, 14-21); Mar. (244, 15-19); Apr. (44, 9-17); May (2, 8-10); Aug. (9, 12-13); Sept. (1, 10); Oct. (1, 13); Dec. (130, 11-17).
BAY: Salinity 0/0-23.3/23.8, temperature 8.3/8.2-31.2/31.0. Number and length: Jan. (7, 14-18); Feb. (354, 14-28); Mar. (24, 15-24); Apr. (35, 17-124); May (17, 17-67); June (20, 58-91); July (14, 66-95); Aug. (25, 67-130); Sept. (5, 91-156); Oct. (10, 85-125); Dec. (6, 13-20).

Family Sciaenidae

Bairdiella chrysura (Lacépède). Silver perch.

BAY: Salinity 0/0-20.5/23.0, temperature 13.6/13.0-30.4/31.7. Number and length: Feb. (114, 94-190); Mar. (22, 105-200); Apr. (21, 90-185); May (5, 109-194); July (13, 148-199); Aug. (109, 136-197); Sept. (5, 148-212); Oct. (10, 107-203); Dec. (5, 103-115).
RIVER: Salinity 4.2/10.1, temperature 28.9/30.2. Number and length: Aug. (7, 147-210).

Cynoscion arenarius Ginsburg. Sand seatrout.

BRIDGE: Salinity 5.0/31.5, temperature 28.0/26.8. Number and length: June (1, 60).
BAY: Salinity 2.6/2.6-20.5/23.0, temperature 21.7/23.0-31.7/31.7. Number and length: Apr. (1, 165); May (23, 30-71); June (3, 74-84); July (32, 50-103); Aug. (75, 70-185); Sept. (4, 91-305); Oct. (4, 62-174).
RIVER: Salinity 0/0-4.2/10.1, temperature 22.8/25.7-28.9/30.2. Number and length: May (4, 40-55); Aug. (8, 75-108).

Cynoscion nebulosus (Cuvier). Spotted seatrout.

BAY: Salinity 9.7/9.7-19.9/24.0, temperature 28.7/28.5-31.0/31.0. Number and length: July (1, 103); Sept. (4, 28-330); Oct. (37, 47-107).

Leiostomus xanthurus Lacépède. Spot.

BRIDGE: Salinity 8.8/29.5-26.4/29.5, temperature 5.2/11.4-18.2/17.5. Number and length: Jan. (69, 9-22); Feb. (83, 15-30); Mar. (10, 13-17); Dec. (954, 7-21).
BAY: Salinity 0/0-17.6/25.0, temperature 9.5/9.3-30.4/31.7. Number and length: Jan. (192, 16-123); Feb. (65, 16-146); Mar. (94, 18-122); Apr. (238, 22-210); May (92, 44-114); June (18, 50-86); July (23, 65-234); Aug. (44, 77-156); Sept. (1, 94); Oct. (22, 85-133); Nov. (2, 83-98); Dec. (7, 20-123).
RIVER: Salinity 0/0-4.2/10.1, temperature 12.7/12.7-28.9/30.2. Number and length: Feb. (1, 21); Mar. (6, 19-22); Aug. (1, 111).

Menticirrhus focaliger Ginsburg. Minkfish.

BRIDGE: Salinity 9.8/30.9, temperature 26.1/21.7. Number and length: Apr. (1, 29).

Micropogon undulatus (Linnaeus). Atlantic croaker.

BRIDGE: Salinity 15.5/27.9-21.4/30.0, temperature 5.2/11.4-26.0/25.8. Number and length: Jan. (4, 7-15); May (1, 17); Nov. (1, 10); Dec. (75, 7-20).
BAY: Salinity 0/0-23.1/25.3, temperature 8.3/8.2-31.2/31.7. Number and length: Jan. (10, 12-45); Feb. (3, 14-203); Mar. (46, 13-177); Apr. (57, 26-238); May (48, 29-213); June (8, 51-235); July (51, 55-234); Aug. (271, 80-203); Sept. (1, 125); Oct. (13, 98-192); Nov. (7, 29-149); Dec. (9, 12-25).
RIVER: Salinity 0/0-4.2/10.1, temperature 10.3/10.3-28.9/30.2. Number and length: Jan. (1, 15); Feb. (4, 22-35); Apr. (2, 30-36); Aug. (6, 95-98).

Sciaenops ocellata (Linnaeus). Red drum.

BAY: Salinity 4.1/4.1-16.8/20.6, temperature 20.2/20.2-28.1/29.5. Number and length: Apr. (1, 95); May (1, 140); Oct. (5, 54-65).

Family Ephippidae

Chaetodipterus faber (Broussonet). Atlantic spadefish.

BRIDGE: Salinity 15.1/30.6, temperature 28.1/24.8. Number and length: June (1, 13).
BAY: Salinity 16.8/20.6-17.6/25.0, temperature 28.1/29.5-29.8/29.9. Number and length: Aug. (1, 126); Oct. (1, 52).

Family Mugilidae

Mugil cephalus Linnaeus. Striped mullet.

BRIDGE: Salinity 10.9/30.2-15.8/27.9, temperature 11.3/14.1-12.4/14.8. Number and length: Jan. (1, 29); Dec. (1, 26).
BAY: Salinity 0.3/0.3-17.6/25.0, temperature 8.3/8.2-31.0/31.0. Number and length: Jan. (8, 27-31); Mar. (2, 30-31); Apr. (68, 27-62); May (21, 34-70); June (68, 39-93); July (1, 91); Aug. (31, 60-99); Sept. (2, 110-111); Oct. (3, 176-309).

Mugil curema Valenciennes. White mullet.

BRIDGE: Salinity 13.9/29.9-22.0/25.5, temperature 24.6/21.2-23.6/24.1. Number and length: May (2, 4-23).
BAY: Salinity 2.7/2.7-9.0/9.0, temperature 17.9/17.9-21.2/21.2. Number and length: Mar. (2, 175-181); Sept. (1, 153).

Family Sphyraenidae

Sphyraena borealis DeKay. Northern sennet.

BRIDGE: Salinity 10.4/28.3-22.5/28.8, temperature 23.3/21.5-26.0/25.8. Number and length: Apr. (16, 31-40); May (1, 40).

Family Uranoscopidae

Astroscopus y-graecum (Cuvier). Southern stargazer.

BRIDGE: Salinity 23.8/29.5, temperature 13.8/16.7. Number and length: Dec. (1, 15).
BAY: Salinity 11.2/11.3, temperature 12.7/12.1. Number and length: Feb. (1, 22).

Family Blenniidae

Hypsoblennius sp.

BRIDGE: Salinity 8.8/28.7-24.4/29.7, temperature 23.4/21.5-29.6/27.4. Number and length: Apr. (2, 6); May (32, 4-13); June (7, 5-8).
BAY: Salinity 21.1/21.3, temperature 26.7/26.7. Number and length: May (3, 9).

Family Gobiidae

Gobionellus boleosoma (Jordan and Gilbert). Darter goby.

BAY: Salinity 0/0-16.2/16.2, temperature 9.5/9.3-29.3/29.3. Number and length: Jan. (2, 16-35); Feb. (1, 19); Mar. (7, 24-39); Apr. (2, 38-43); Aug. (18, 14-33); Sept. (21, 12-31); Oct. (4, 14-26); Dec. (2, 21-23).
RIVER: Salinity 0/16.3, temperature 20.5/21.5. Number and length: Oct. (1, 10).

Gobionellus hastatus Girard. Sharptail goby.

BAY: Salinity 5.9/7.3-6.1/17.4, temperature 16.2/16.1-19.3/18.9. Number and length: Mar. (3, 59-78); Dec. (1, 44).

Gobiosoma bosci (Lacépède). Naked goby.

BAY: Salinity 0/0-8.0/19.4, temperature 9.5/9.3-31.0/31.0. Number and length: Jan. (3, 35-39); Mar. (1, 25); July (7, 25-47); Aug. (5, 11-15).
RIVER: Salinity 0/16.3, temperature 20.5/21.5. Number and length: Oct. (1, 22).

Unknown Gobiidae.

BAY: Salinity 1.7/7.8-11.9/11.9, temperature 22.7/23.6-29.3/29.3. Number and length: Apr. (35, 6-7); Aug. (2, 9-10).

Family Trichiuridae

Trichiurus lepturus Linnaeus. Atlantic cutlassfish.

BAY: Salinity 6.7/15.5-20.5/23.0, temperature 25.1/23.5-29.1/28.8. Number and length: Apr. (3, 223-276); Sept. (1, 479); Oct. (1, 795).

Family Scombridae

Scomberomorus maculatus (Mitchill). Spanish mackerel.

BAY: Salinity 4.8/5.1-9.7/9.7, temperature 31.0/31.0-31.2/31.1. Number and length: July (4, 65-152).

Family Stromateidae

Peprilus alepidotus (Linnaeus). Harvestfish.

BRIDGE: Salinity 22.8/29.6, temperature 29.6/27.4. Number and length: June (2, 11-12).
BAY: Salinity 6.5/13.1-20.5/23.0, temperature 21.0/22.3-30.4/31.7. Number and length: July (1, 64); Aug. (13, 67-127); Sept. (44, 17-62); Oct. (2, 34-135).

Peprilus triacanthus (Peck). Butterfish.

BRIDGE: Salinity 15.5/30.7-26.3/29.5, temperature 5.3/11.4-26.0/25.8. Number and length: Jan. (2, 26-27); Feb. (1, 13); Mar. (2, 18-30); May (1, 19); Dec. (13, 13-42).
BAY: Salinity 2.6/2.6-10.8/20.6, temperature 21.7/23.0-27.0/28.0. Number and length: Apr. (8, 68-85); July (1, 44); Oct. (1, 150).

Family Triglidae

Prionotus tribulus Cuvier. Bighead searobin.

BRIDGE: Salinity 13.3/30.9, temperature 27.6/28.9. Number and length: Aug. (1, 6).
BAY: Salinity 1.2/1.5-16.1/23.3, temperature 16.2/16.2-30.9/30.9. Number and length: Mar. (1, 47); June (3, 24); Aug. (1, 41); Oct. (4, 21-86); Nov. (2, 26-28).

Family Bothidae

Citharichthys spilopterus Günther. Bay whiff.

BRIDGE (specimens probably this species; identified as either *Citharichthys* sp. or *Etropus* sp.): Salinity 15.8/27.9-26.4/29.8., temperature 5.2/11.4-14.2/16.0. Number and length: Jan. (1, 13); May (1, 13); Nov. (1, 11); Dec. (2, 10-11).
BAY: Salinity 8.0/8.0-16.7/23.1, temperature 13.6/13.0-29.3/29.3. Number and length: Jan. (4, 12-20); Feb. (1, 27); Aug. (1, 101).

Paralichthys lethostigma Jordan and Gilbert. Southern flounder.

BAY: Salinity 2.5/2.7-8.5/21.4, temperature 15.2/16.5-23.7/23.7. Number and length: Mar. (1, 32); Apr. (2, 57-59).

Unknown Bothidae.

BRIDGE: Salinity 18.2/30.1-26.3/29.8, temperature 5.3/11.4-13.2/16.3. Number and length: Jan. (7, 9-13); Dec. (1, 10).
BAY: Salinity 9.0/9.0, temperature 21.2/21.2. Number and length: Sept. (1, 14).

Family Soleidae

Achirus lineatus (Linnaeus). Lined Sole.

BRIDGE (specimen probably this species; identified as a Soleidae): Salinity 22.8/29.6, temperature 29.6/27.4. Number and length: June (1, 3).
BAY: Salinity 0/0, temperature 27.8/27.8. Number and length: Aug. (1, 51).
RIVER: Salinity 0/16.3, temperature 20.5/21.5. Number and length: Oct. (2, 9-14).

Trinectes maculatus (Bloch and Schneider). Hogchoker.

BAY: Salinity 0/0-16.8/20.6, temperature 16.2/16.1-30.4/31.7. Number and length: Jan. (2, 30-69); Mar. (2, 67-90); Apr. (2, 46-52); May (1, 35); June (2, 43-51); July (3, 23-62); Aug. (8, 10-71); Oct. (3, 89-96).
RIVER: Salinity 0/15.3-0.5/16.1, temperature 25.0/28.0-23.1/30.0. Number and length: Sept. (1, 11); Oct. (1, 60).

Family Cynoglossidae

Symphurus plagiusa (Linnaeus). Blackcheek tonguefish.

BAY: Salinity 0/0-10.8/20.6, temperature 21.7/23.0-29.3/29.3. Number and length: Apr. (1, 45); Aug. (12, 17-60); Oct. (1, 59).

Family Balistidae

Aluterus schoepfi (Walbaum). Orange filefish.

BRIDGE: Salinity 24.4/29.7, temperature 26.1/26.3. Number and length: June (1, 57).

Monacanthus hispidus (Linnaeus). Planehead filefish.

BRIDGE: Salinity 15.2/30.6-24.4/29.7, temperature 12.1/18.7-29.5/29.4. Number and length: May (3, 17-24); June (7, 13-21); July (1, 16); Aug. (3, 28-30); Oct. (1, 19); Nov. (2, 21).
BAY: Salinity 21.1/21.3, temperature 26.7/26.7. Number and length: May (1, 17).

Family Tetraodontidae

Sphoeroides nephelus (Goode and Bean). Southern puffer.

BRIDGE: Salinity 8.8/28.7-23.7/29.6, temperature 10.9/14.1-29.6/27.4. Number and length: Jan. (1, 12); Apr. (2, 11-15); May (6, 7-12); June (2, 12-13); July (1, 10).
BAY: Salinity 0/0-9.6/20.3, temperature 20.8/20.3-31.0/31.0. Number and length: Apr. (1, 92); May (2, 22-31); June (2, 43-50); July (1, 31); Aug. (2, 49-53).

Family Diodontidae

Chilomycterus antillarum Jordan and Rutter. Web burrfish.

BAY: Salinity 21.1/21.3, temperature 26.7/26.7. Number and length: May (2, 17).

Chilomycterus schoepfi (Walbaum). Striped burrfish.

BAY: Salinity 17.6/25.0, temperature 29.8/29.9. Number and length: Aug. (1, 215).

SUMMARY

Gulf menhaden, *Brevoortia patronus*, and other species of fishes were collected from Pensacola Bay, East Bay, and East Bay River from December 1969 to October 1971. Larval menhaden, 10 to 32 mm TL, entered from the Gulf of Mexico from December to April. Monthly sizes indicated

two spawning peaks occurred during the spawning season from late October to late March. Larvae entered at smaller sizes than reported for estuaries on the Louisiana and southern Florida coasts. Early growth was in the upper Bay, and as the young increased in size they moved Gulfward. Young, 31 to 50 mm TL, in April appeared to attain a size of 91 to 120 mm by August. Small catches after August indicated that most juveniles had moved out of the estuary. Gulf menhaden and bay anchovy, *Anchoa mitchilli*, made up about 92% of all fish caught. The latter may be the most important competitor of menhaden for food and space in East Bay.

Eighty-four species of fishes, representing 46 families, were captured. The number and length of each species by month are presented for the areas from which it was caught. Also included are the salinity and temperature ranges at capture. Species not previously recorded from Pensacola estuaries are flat anchovy, *Anchoviella perfasciata*; rough silversides, *Membras martinica*; chain pipefish, *Syngnathus louisianae*; and web burrfish, *Chilomycterus antillarum*.

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